INGONISH FERRY, NOVA SCOTIA

PRELIMINARY DESIGN OF TRAINING WALLS

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Prepared for: Small Craft Harbours Branch
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I. INTRODUCTION

This report has been prepared in response to a request from the Department of Fisheries and Oceans made to the Atlantic Region of PWC for a class "D" cost estimate for training walls in order to canalize the entrance channel to Ingonish Harbour. These training walls were proposed in the PWC report entitled Ingonish Ferry, Nova Scotia - Harbour Entrance Improvement Study [1] as a remedial measure to the sedimentation problem at the entrance channel.

One of the remedial measures (presented in [1]) proposed to alleviate the siltation problem in the inlet channel is the canalizing of the channel with training walls. It is proposed that these walls be positioned such that the cross-sectional opening A_c of the inlet channel (below MWL) be approximately 220 m^2. It is believed that for this value of A_c, the tidal prism flushing power will be sufficient to create a self flushing inlet. Thus for a channel width of 50 m (at MWL), a dredged depth of 4.5 m (below datum) should be maintained. Reference should be made to [1] for background information.

II CANALIZE THE INLET CHANNEL - TRAINING WALLS

2.1 Conceptual Description

The inlet channel is to be canalized by the use of training walls. These walls consist of a rubble mound structure on the north side of the inlet channel and an armour protected apron on the south side of the inlet channel (see sketch 1). These walls should be positioned such that the canalized channel follows the natural inlet channel as closely as possible and the width of the canalized channel is 50 m at mean water level. The rubble mound structure on the north side of the channel is to extend out from the shoreline approximately 230 m to a depth of 4.5 m below datum. The south side of this structure is to be uniform along its length such that eddy shedding resulting from wave action will be kept to a minimum. The armour protected apron on the south side of the channel will have the approximate location and dimensions as indicated on sketches 1 and 3.

2.2 Sediment Motion

As was indicated in [1], it is estimated that the semi-diurnal tidal flow into and out of Ingonish Harbour has the capability to flush out of the inlet channel the sediments whose diameter D is 15 mm or less. Any sediments that are deposited in the inlet channel, are deposited primarily due to short wave action. Thus to maintain the design depth in the channel, it is desirable not to have any sediments larger than say, D = 12 mm, deposited in the inlet channel by (short) wave action. To accomplish this, the canalized channel should extend to a distance offshore such that a sand particle with a diameter D = 12 mm will be on the threshold of motion

(which is a function of the water depth d at that distance offshore, the significant wave height H_s and the wave period T).

Three techniques (to estimate the initiation of sediment motion, Kamphuis [2], Komar [3], Hallermeier [4]) were used in order to estimate the depth of water at which a 12 mm sand particle would just begin to move under the action of a wave with H_s = 1.50 m and T = 10 sec. This wave height is exceeded 5% of the time at Ingonish Ferry (see shallow water wave climate in [1]). All three techniques yielded results which were in agreement. It was concluded as a result of this analysis, that the rubble mound structure on the north side of the inlet channel should extend out from the shoreline to a depth of 4.5 m. With this configuration of training walls, it is estimated that any sediment particles that do get deposited in the inlet channel by short wave action would be 12 mm in diameter or less. This material should subsequently be flushed out from the inlet channel over the course of semi-diurnal tides.

Inspite of the canalization and its effectiveness in flushing out sediment particles 15 mm in size or less, it should be noted that violent storms can easily transport large quantities of coarse material quickly and thus could possibly cause sedimentation in the inlet. Furthermore, should the sand bar system north of the inlet be breached due to storm action (allowing tidal flow through the breach), the hydraulic characteristics of the canalized inlet will change significantly resulting in reduced self-flushing capacity in the inlet. Historical data, suggest that the sand bar system is quite stable, the possibility of a breach is, therefore, considered to be a rather remote.

2.3 Rubble Mound Structure and Apron

The rubble mound structure on the north side of the inlet channel is a preliminary (desk top) design based on design procedures outlined in the Shore Protection Manual [5]. A significant wave height of 3.0 m was used in the calculations (see shallow water wave climate in [1]). Some typical sections of the rubble mound structure are shown in sketch 2. The information obtained from the above calculations was used to size the armour required to protect the apron on the south side of the inlet channel. A typical section of the apron is shown in sketch 3.

It should be clearly realized that any rubble mound structure proposal should be thoroughly evaluated for stability (optimization) in a physical model study. This has not been done for the proposal presented in this report.

Dredging of the canalized inlet to 4.5 m (below datum) will be required. The area to be dredged is shown on sketch 1. On the canal side of the two structures, the armour protection and filter should extend down to at least -4.5 m. This will require dredging before placement of the filter stone.

The estimated total volume of dredging required is 12000 cubic meters place measure.

Before any final designs of training walls can be completed, some subsurface data on the bearing capacity of the foundation material will be required.

III CLASS 'D' COST ESTIMATES

The following tables summarize the class 'D' cost estimates for this proposal.

Rubble Mound Structure on North Shore of Channel

Material	Range (tonnes)	Quantity (tonnes)	at $/t	Costs
Armour	6 - 10	12,900	17.00	219,300
Armour	4 - 6	30,600	16.00	489,600
Filter	0.5 - 1.0	21,600	14.75	318,600
Core		24,400	11.50	280,600
Total		89,500		$1,308,100

Apron on South Side of Channel

Material	Range	Quantity	at $/t	Costs
Armour	6 - 10	9,300	17.00	158,100
Armour	4 - 6	3,400	16.00	54,400
Filter	0.5 - 1.0	8,100	14.75	119,475
Core		48,500	11.50	557,750
Total		69,300		$889,725

Dredging of Channel to 4.5 m below Datum

Vol. of dredged material = 12,000 CMPM @ $12/m^3 = $144,000

Mobilization and demobilization

of construction and dredging equipment = $258,175

TOTAL COSTS = $2,600,000

Note: Engineering inspection, survey costs and geotechnical costs are not included.

REFERENCES

[1] Fournier, C.P., 1984, Ingonish Ferry, Nova Scotia, Harbour Entrance Improvement Study. A Public Works Canada Publication.

[2] Kamphuis, J.W., May 1982, Coastal Mobile Bed Modelling from a 1982 Perspective. Dept. of Civil Eng., Queen's University, Kingston, Canada. C.E. Report No. 76.

[3] Komar, P.D. and Miller, M.C., Sediment Threshold under Oscillatory Waves. Proc. of the 14th Conf. on Coastal Engineering, Copenhagen, Denmark, 1974.

[4] Hallermeier, R.J., Sand Motion Initiation by Water Waves: Two Asymptotes. Journal of the Waterway, Port, Coastal and Ocean Division, August 1980.

[5] U.S. Army Corp of Engineers - Shore Protection Manual 1977.

SKETCH 1

PLAN VIEW TRAINING WALLS

MEAN WATER LEVEL = 0.82m ABOVE DATUM

TAKEN FROM DPW SOUNDING SURVEY AUG 10, 1983

1:2000

SOUTH BAY INGONISH

4 585 000

4 585 200

4 585 400

4 585 600

2649 272m

TO STA KELTIC

HNT

ABANDONED CRIB

230 m

6t-10t (2 layers)

4t-6t (2 layers)

1 (layer)

SECTION 1

SECTION 2

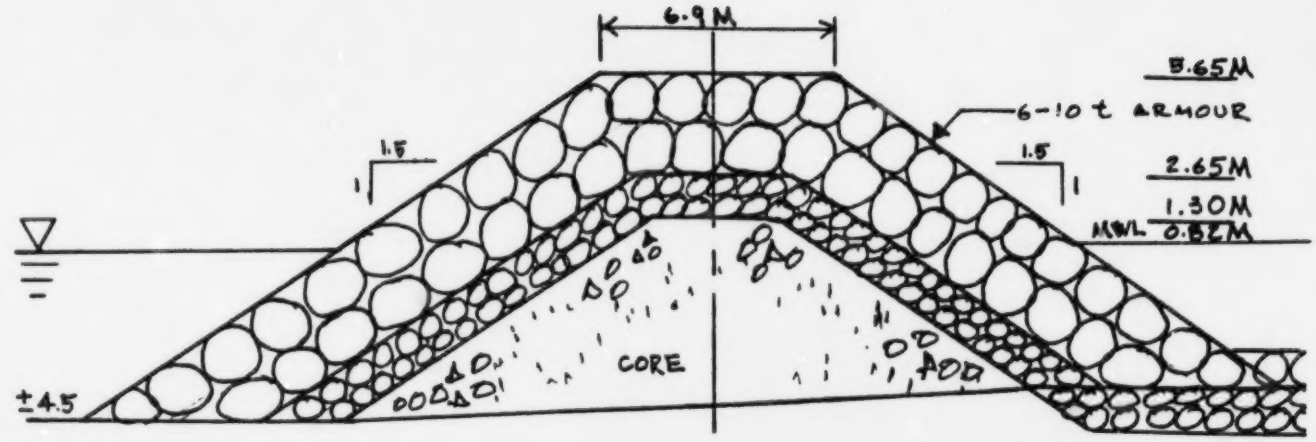
SECTION 3

SECTION 4

SECTION 5

(77.5°)

AREA TO BE DREDGED



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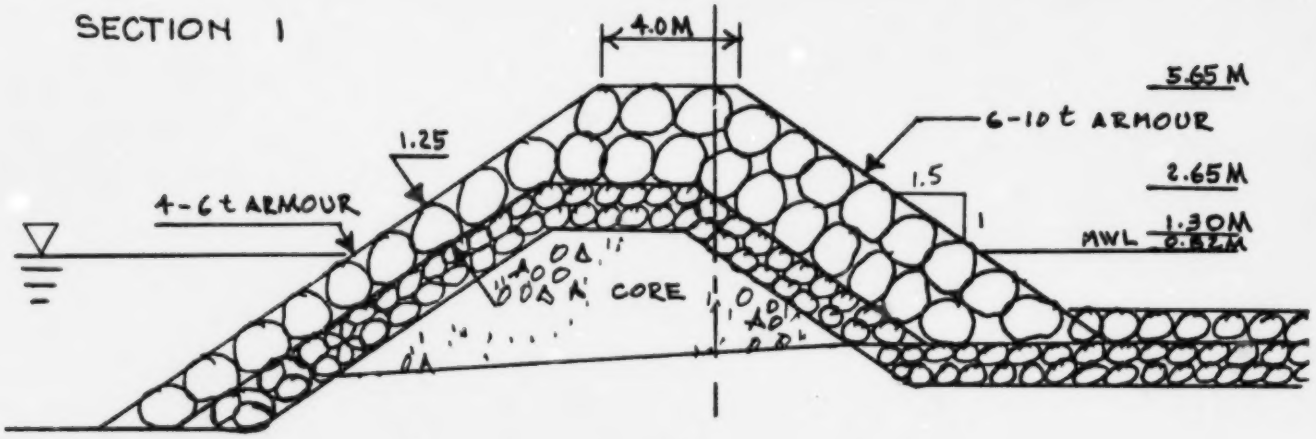

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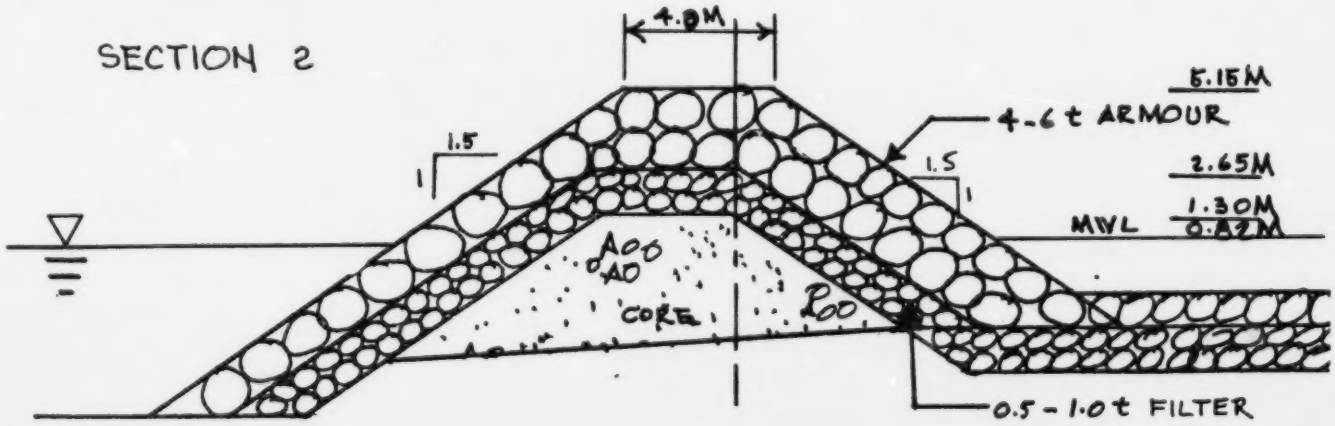


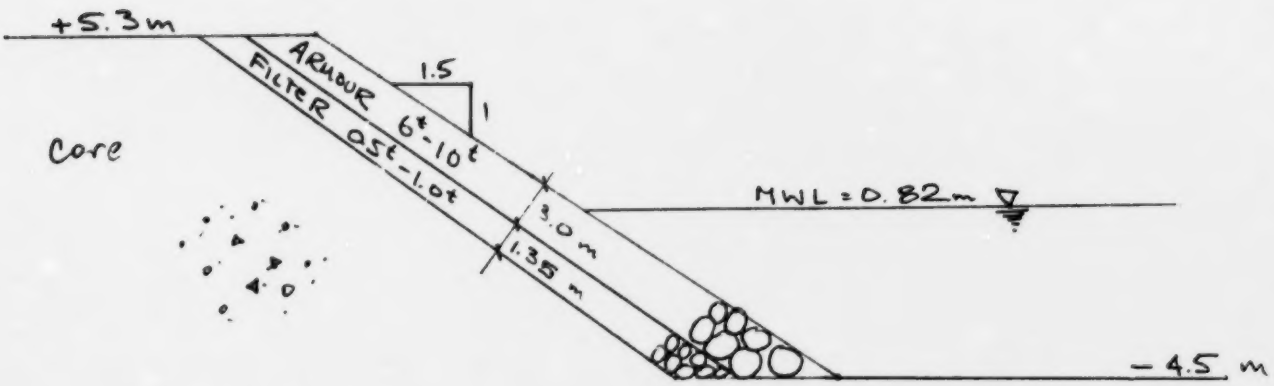
SECTION 3

SKETCH 2

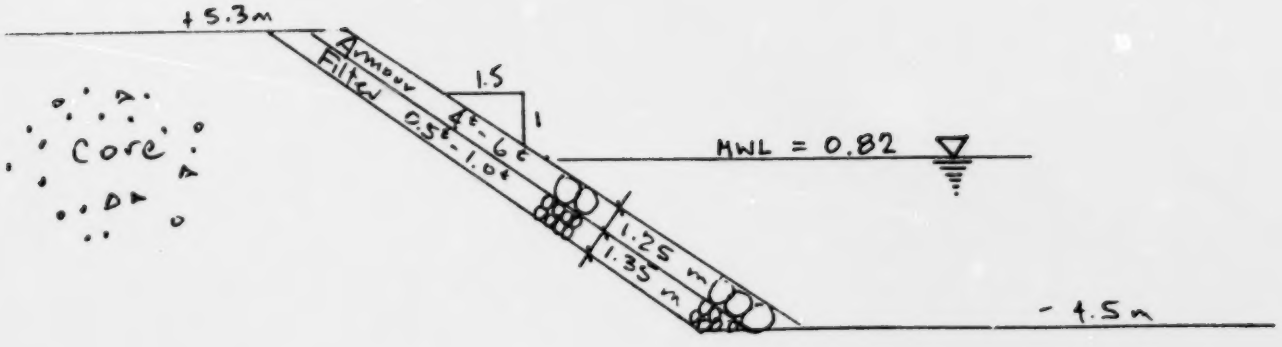
TYPICAL SECTION THROUGH RUBBLE MOUND STRUCTURE (SEE SKETCH 1).

NOTE: MWL = 0.82 m
HHWMT = 1.28 m

SKETCH 3 - Typical sections through Apron



SECTION 4



SECTION 5